GROUND WATER RESOURCES

Hamilton County

Open File Report 86-40 WRD

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GROUNDWATER RESOURCES OF HAMILTON COUNTY

Introduction

Approximately 90% of the residents of Hamilton County rely on groundwater as the source of their drinking water. It is estimated that the use of groundwater in the county currently approaches 1.0 billion gallons per year. For comparison, this amount would provide each resident with 146 gallons of water a day during the year. Actually, few if any households use this much water, and the rather large annual per capita use reflects the greater water requirements of the county's industries, agribusinesses and municipalities.

The users of groundwater in the county draw their supplies from several different geologic sources. Various factors must be considered in determining the availability of groundwater and the adequacy of a supply source:

distribution - having water where it is needed

accessibility - affects the costs for drilling wells and pumping water

yield - relates to the magnitude of the supply that can be sustained

quality - determines for what purposes the water can be used

In terms of these factors, there are few locations in Hamilton County where the availability of groundwater is not limited to some degree. The most common limitation is poor water quality, that is, highly mineralized groundwater. Secondary limitations are generally related to poor distribution, small yields from some sources, and poor accessibility due to the great depths to adequate sources.

Occurrence of Groundwater in Hamilton County

The occurrence of groundwater is influenced by geology -- the position and thickness of the rock units, their ability to store and transmit water, and their physical and chemical make-up. Geologic units that store and transmit water and yield appreciable amounts to wells are called aquifers. The best aquifers are usually composed of unconsolidated sand and gravel, porous sandstone, and porous or fractured limestone and dolostone. Other units composed of materials such as clay and silt, shale, siltstone, and mudstone yield little or no water to wells. These impermeable units are called aquicludes or aquitards, and commonly separate one aquifer unit from another.

In Hamilton County, there are two principal sources from which users obtain water supplies: the loose, unconsolidated materials near the land surface that comprise the surficial aquifer, and several deep-rock aquifers. Between the surficial aquifer and the deep Cambro-Ordovician aquifer are two other water-bearing units, the Mississippian and the Devonian aquifer systems. However, throughout Hamilton County the water contained in these aquifers is highly mineralized and often of too poor quality for human or livestock use. Figure 1 is a cross section showing the geologic relations of aquifers beneath the county. Each aquifer has its own set of geologic, hydrologic, and water-quality characteristics which determine the amount and potability (suitability for drinking) of water it will yield. Table 1 lists the geologic and hydrogeologic characteristics of the aquifer underlying Hamilton County.

Surficial Aquifers

Unconsolidated deposits at the land surface are comprised of mixtures of clay, silt, sand, gravel, and assorted boulders. The water-yielding potential of surficial deposits is greatest in units composed mostly of sand and/or gravel. Three types of surficial aquifers are used: the alluvial aquifer, the drift aquifer, and the buried channel aquifer.

The alluvial aquifers (Fig. 2a) consist mainly of sand and gravel transported and deposited by modern and Pleistocene streams and make up the floodplains and terraces in major valleys. Alluvial deposits are shallow, generally less than 50-60 feet, and thus may be easily contaminated by the infiltration of surfacewater.

The drift aquifer (Fig. 2b) is the thick layer of clay-to boulder-size material (till) deposited over the bedrock by glacial ice which invaded the county several times in the last two million years. The composition of the glacial drift varies considerably, and in many places does not yield much water. There are however, lenses or beds of sand and gravel in the drift, which are thick and widespread enough to serve as dependable water sources. Usually one or two sand layers can be found in most places that will yield minimum water supplies for domestic wells.

The buried channel aquifer (Fig. 3a) consists of stream alluvium of partially filled valleys that existed before the glacial period. The valleys were overridden by the glaciers, and are now buried under the glacial drift. They may or may not coincide with present day alluvial valleys.

The distribution, yield, and water-quality characteristics for the surficial aquifers are summarized in Figures 4 and 5 and Table 3. An indication of accessibility can be obtained by comparing the elevations of the top (the land surface) and the bottom (the bedrock surface) of the surficial deposits in Figures 6 and 7. The thickness of the glacial drift or the depth of buried channels, is determined by subtracting the elevations at selected locations.

Water levels in the surficial aquifers are difficult to analyze, because water rises to different levels in wells drilled into alluvial, buried-channel, and drift aquifers. The water table in the shallow drift aquifer generally slopes from high land areas toward the streams, and, changes noticeably throughout the year in response to recharge from precipation. Water levels in the alluvial aquifer fluctuate somewhat in the same way as those in the shallow drift aquifer; however, the main influence on the alluvial aquifer is the stage (level) of the associated streams. Water levels will be high during periods of high stream stage and low during low-stage periods. Deeper drift and buried channel aquifers are under confined (artesian) conditions and are generally unaffected by local recharge-discharge relationships.

Water levels in the drift aquifers commonly are from 10-50 feet below the land surface, and those in the buried-channel aquifers have been reported to be as low as 50 feet below the land surface. The water levels in alluvial wells are from 4 to 20 feet below the flood plain surface.

Rock Aquifers

Below the drift and other surficial materials is a thick sequence of layered rocks, formed from deposits of shallow seas that alternately covered the state during the last 600 million years. The geologic map (Figure 8) shows the geologic units which form the surface of this rock sequence. The aquifers (Fig. 3b) are the water-bearing rock units, mostly limestones and sandstones. Rocks of Pennsylvanian and Mississippian age lie below the glacial drift in Hamilton County. The Pennsylvanian rocks are mostly shales and siltstones with minor sandstones and limestones. Because shales dominate, the Pennsylvanian sequence acts as an aquiclude and only locally can water be produced from the permeable members. The water yields are generally low. Water quality data extrapolated from nearby counties indicate that the water is highly mineralized with high concentrations of dissolved solids, sulfate and sodium.

The Mississippian Aquifer is the most frequently utilized groundwater source in Hamilton County, and consists of a series of limestones and dolostones. Yields range from 10-75 gpm. The Devonian aquifer is used locally by rural residents. The main water-producing units in the Devonian are a series of limestones and dolostones. The Cambro-Ordovician aquifer is the major deep aquifer in the county, and includes the St. Peter Sandstone, the Prairie du Chien Dolomite, and the Jordan Sandstone, the latter being the major water producer. The maps in Figure 12 refer to the Jordan aquifer, the lower two units of the Cambro-Ordovician aquifer. The St. Peter sandstone, being highly friable, is generally cased-out in the deep wells.

The relative accessibility of groundwater in rock aquifers depends on the depth to the aquifer. The deeper a well must be, the greater the cost for well construction and pumping. The depths to, and thicknesses of, units at specific sites, will vary somewhat because of irregularities in the elevation of the land surface, and in the elevation of the underlying rock units. Estimates of depths and thicknesses can be made by comparing Figure 6 with the maps of aquifer elevations in Figures 10, 11, and 12. The range in depth below land surface to the top of the county's principal bedrock aquifers is given for each township in Figure 9.

A second factor affecting groundwater accessiblility is the level to which the water will rise in a well (the static water level). Throughout the county, water in the rock aquifers is under artesian pressure, and rises in wells once the aquifer is penetrated. This can reduce the cost of pumping. Average static water levels for Hamilton County wells are shown in Figures 12, 13 and 14.

Average rates of yield and water quality characteristics for each of the aquifers are summarized in the maps in figures 10, 11, 12 and Table 4. Figure 14 shows typical wells in Hamilton County, which are indexed in Figure 13.

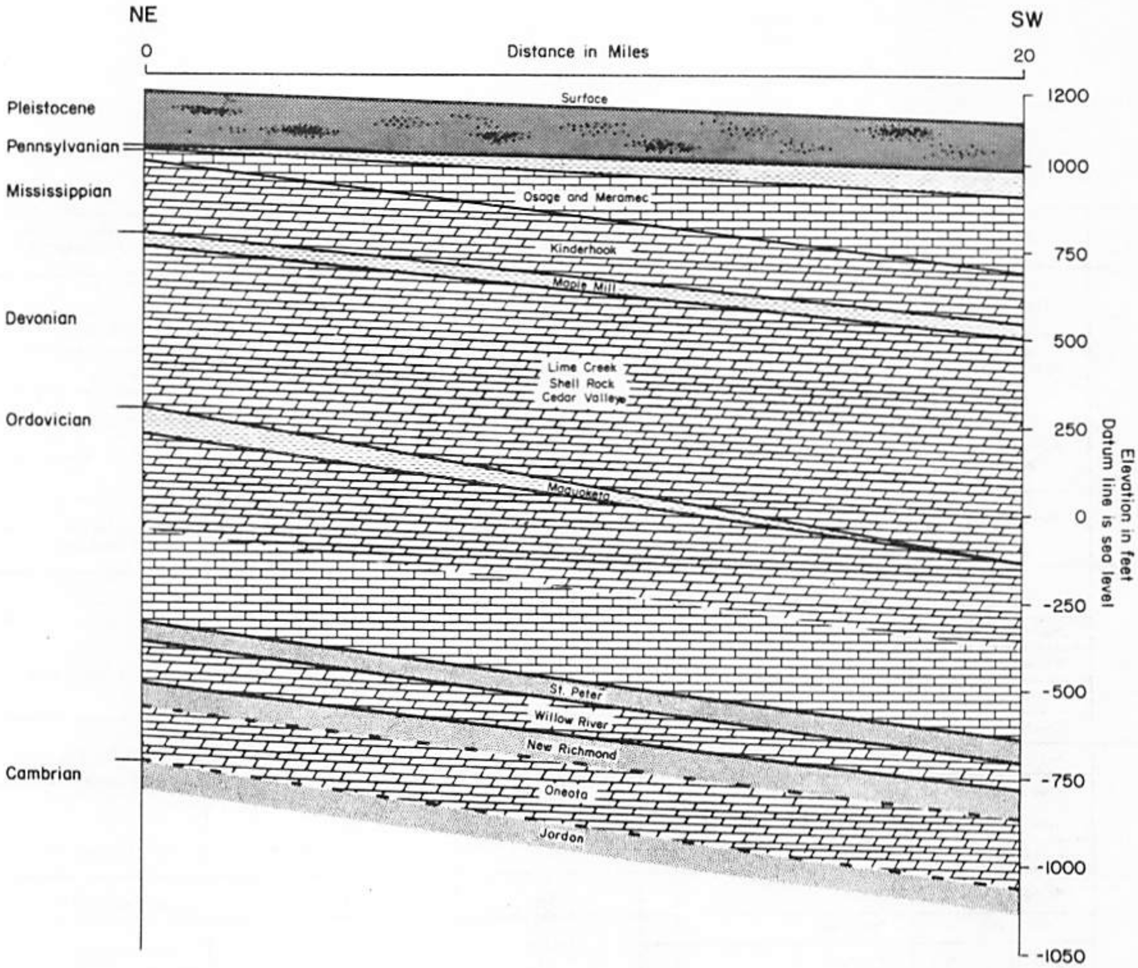
Table 1

GEOLOGIC AND HYDROGEOLOGIC UNITS IN HAMILTON COUNTY

Geologic Age	Rock Unit	Description	Thickness Range	Hydrogeologic Unit	Water-Bearing Characteristics
Quaternary	Alluvium	Sand, gravel, silt and clay	10-265	Surficial Aquifer	Fair to large yields (25-50 gpm)
	Glacial Drift	Predominantly till containing scattered irregular bodies of sand and gravel			Low yields (less than 10 gpm)
	Buried Channel Deposits	Sand, gravel, silt and clay			Small to large yields
Pennsylvanian	Cherokee Gp.	Shale, clay, siltstone, sandstone and limestone	0-145	Aquiclude	Low yields from limestone and sandstone
Mississippian	St. Louis Fm.	Limestone and dolomite, cherty, oolitic	200-350	Mississippian Aquifer	Fair to low yields
	Burlington Fm.				
	Gilmore City Fm.				
	Hampton Fm.				
	North Hill Gp.	Shales	100-150	Aquiclude	Does not yield water
Devonian	Yellow Spring Gp.				
	Lime Creek Fm.	Dolomite	550-650	Devonian Aquifer	Fair to low yields
	Cedar Valley Fm.	Limestone and dolomite			
	Wapsipinicon Fm.				
Ordovician	Maquoketa Fm.	Shale	0-300	Aquiclude	Does not yield water
	Galena Gp.	Dolomite	160-220	Minor Aquifer	Low yields
	Platteville Fm. Glenwood Fm.	Shale			
	St. Peter Fm.	Sandstone	25-50	Cambro-Ordovician Aquifer	Fair to high yields (over 500 gpm)
	Prairie du Chien Gp.	Sandy and cherty dolomite	350-425		
Cambrian	Jordan Fm.	Sandstone	40-60		
	St. Lawrence Fm.	Dolomite			
	Tunnel City Gp. Elk Mound Gp.	Shales, carbonates, sandstones			
Precambrian	Undifferentiated	Coarse sandstone, igneous rocks		Base of groundwater reservoir	Not known to yield water

Figure 1

CROSS-SECTION FROM NE TO SW ACROSS HAMILTON COUNTY



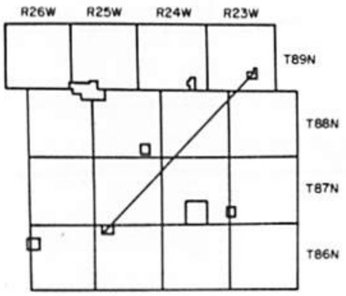
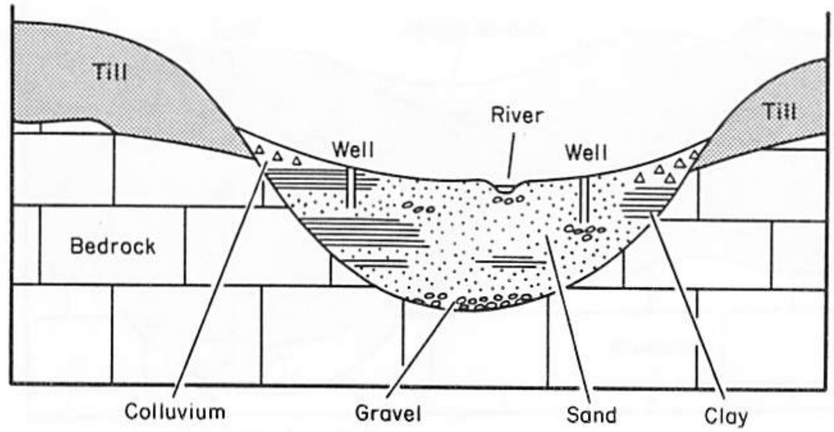


Figure 2a

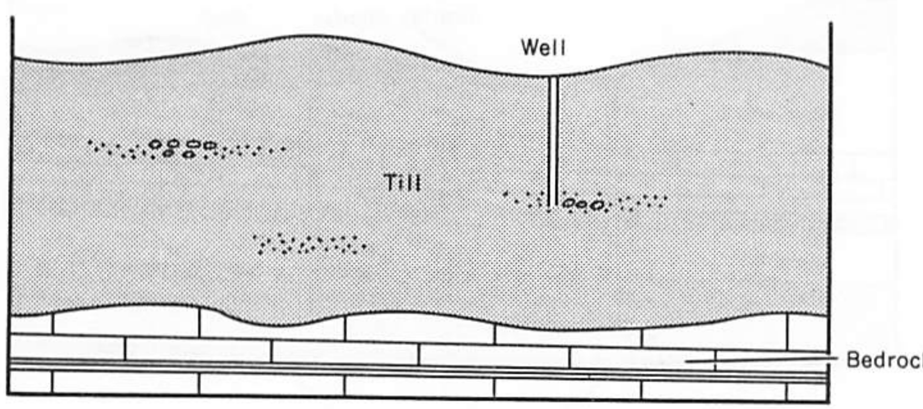
ALLUVIAL AQUIFER



An Alluvial aquifer is a sand and gravel deposit which allows relatively free water movement.

Figure 2b

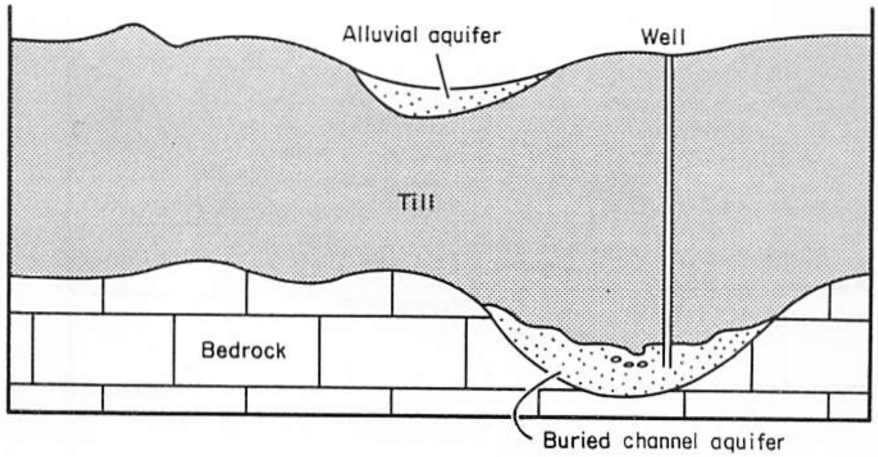
GLACIAL TILL AQUIFER



A till aquifer is formed by thin discontinuous sand and gravel zones within less permeable drift materials.

Figure 3a

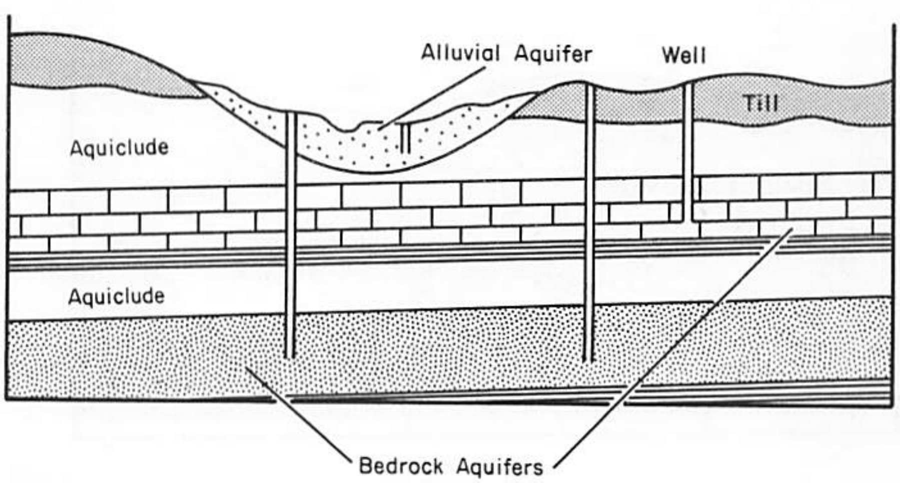
BURIED CHANNEL AQUIFER



A pre-existing landscape was buried by the glacial till. The buried valleys may contain good sources of water.

Figure 3b

BEDROCK AQUIFER



A Bedrock aquifer is a water bearing rock formation which is often far below the land surface. Most shallow wells are not completed in bedrock, but rather are finished in consolidated alluvial material.

Figure 4

DISTRIBUTION OF SURFICIAL AQUIFERS

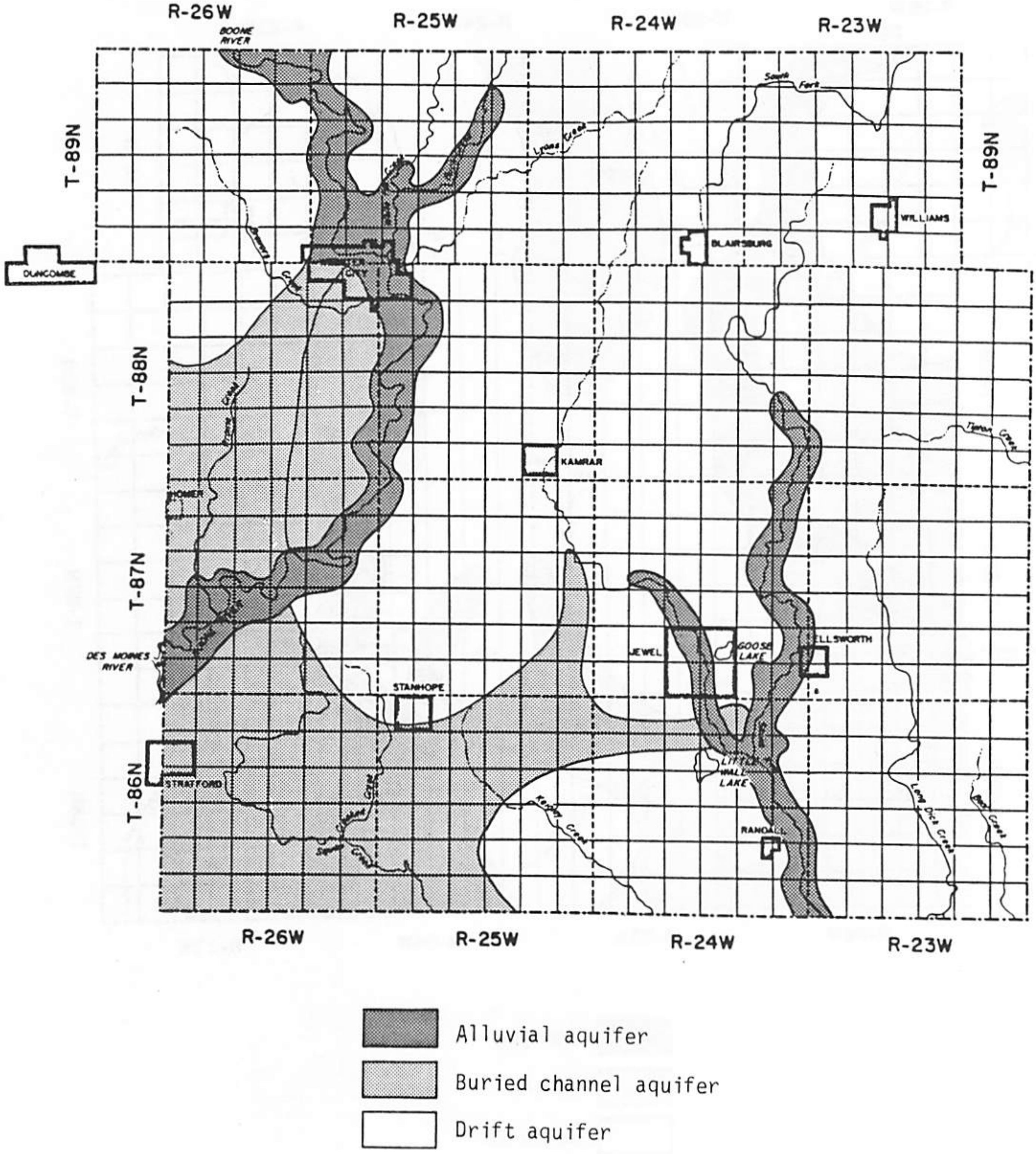


Figure 5

WATER YIELDS TO WELLS OF SURFICIAL AQUIFERS
IN GALLONS PER MINUTE

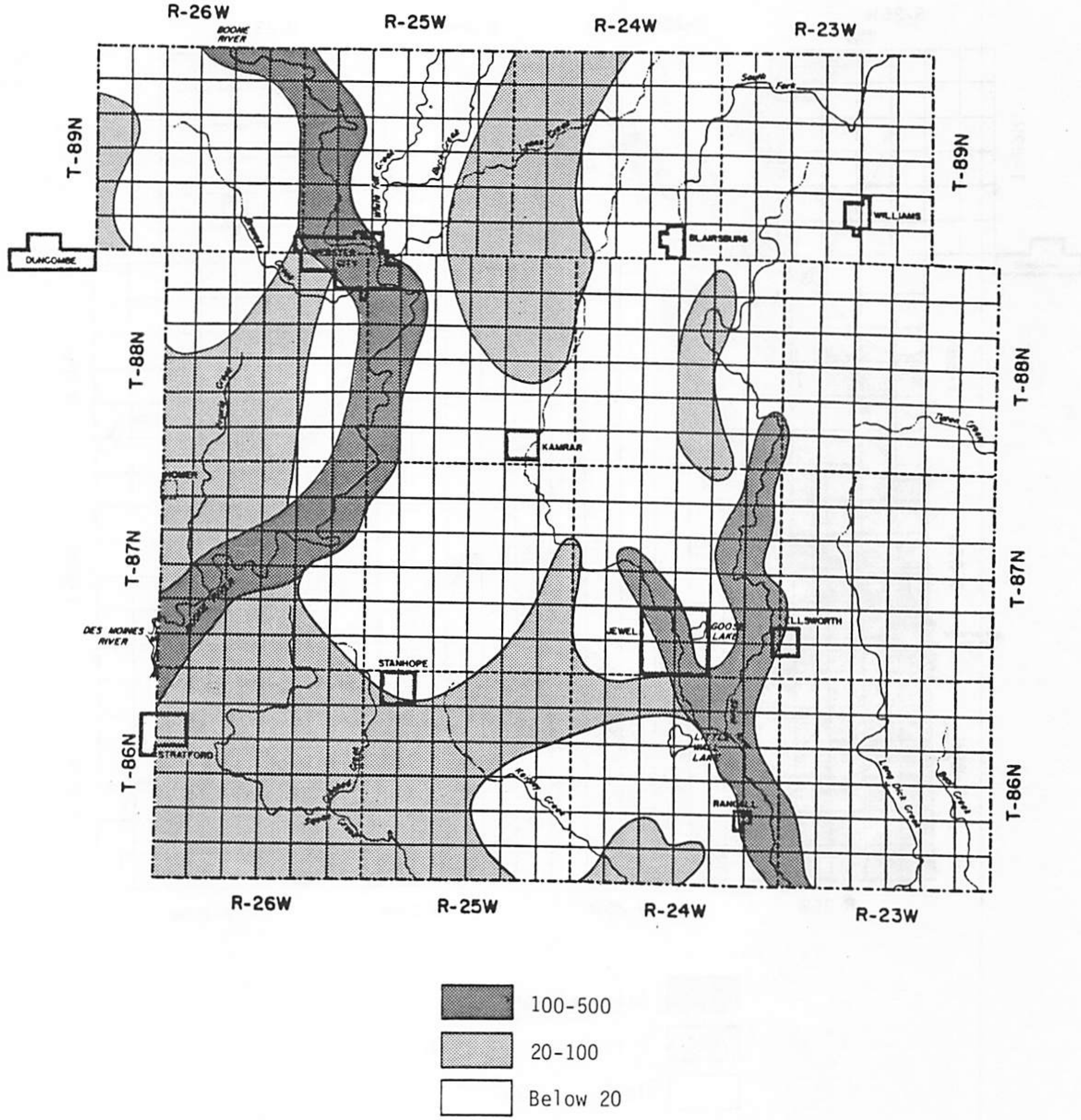


Figure 6

ELEVATION OF LAND SURFACE IN FEET ABOVE MEAN SEA LEVEL

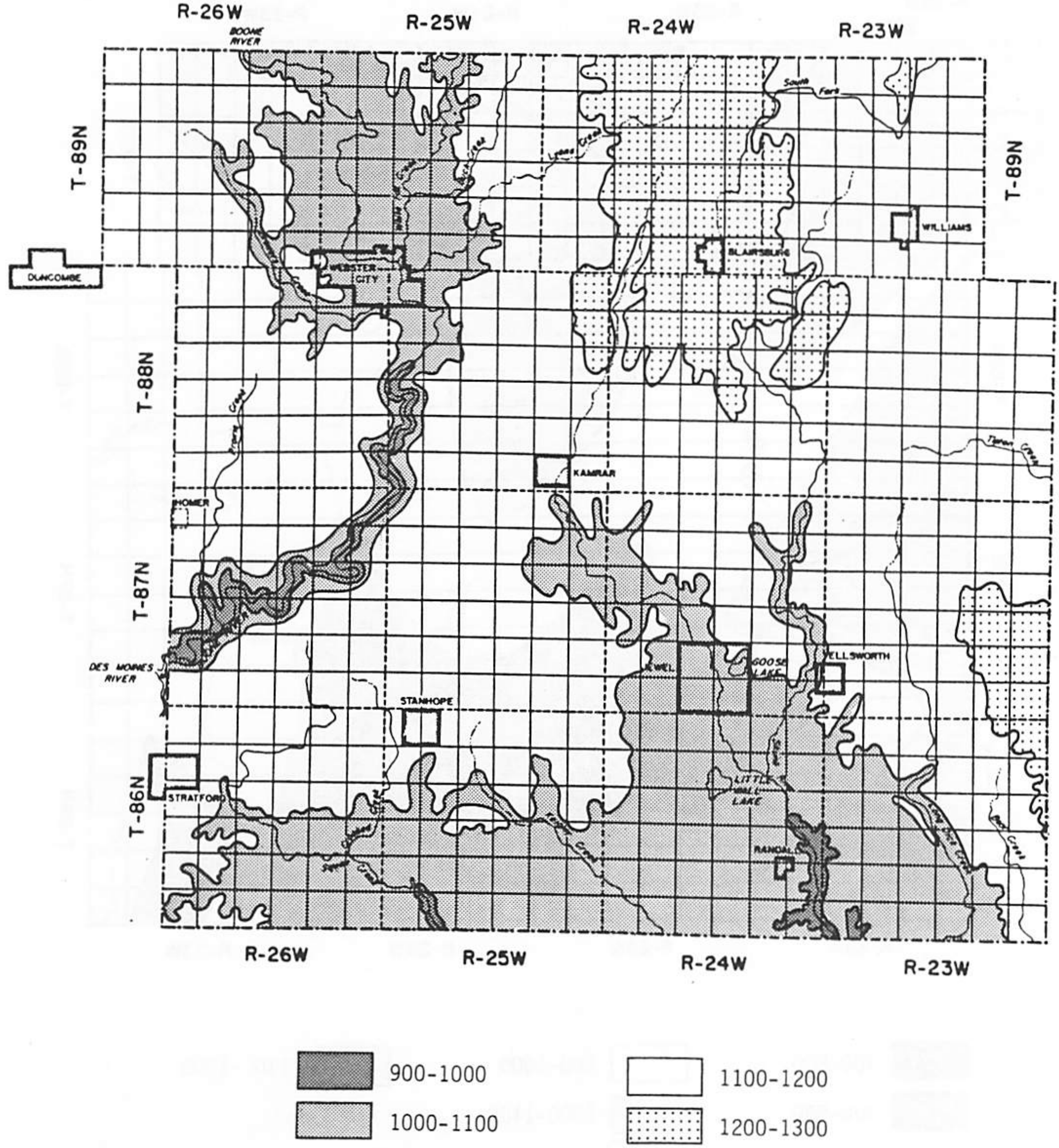


Figure 7

ELEVATION OF BEDROCK SURFACE IN FEET ABOVE MEAN SEA LEVEL

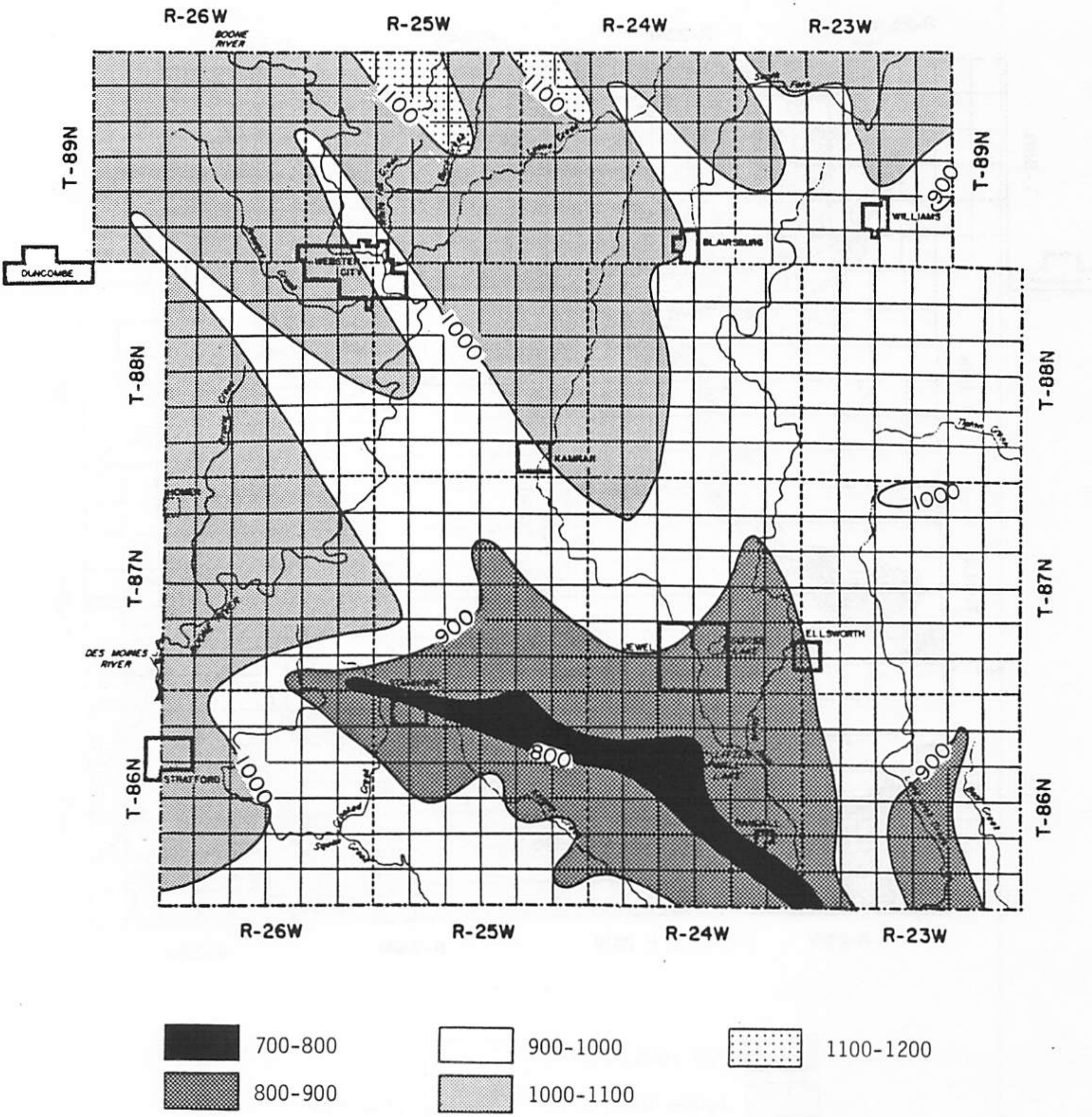


Figure 8

GEOLOGIC MAP

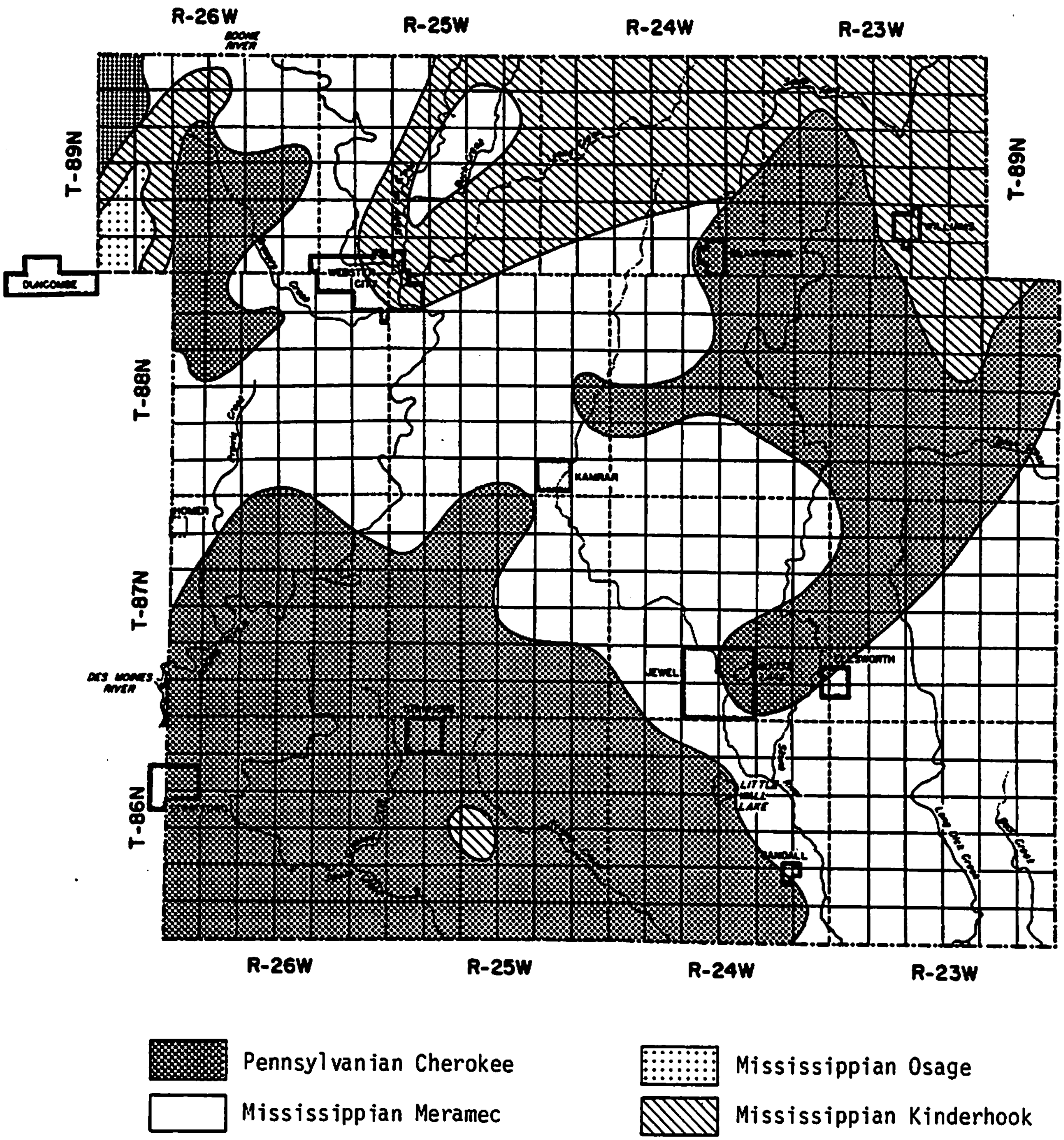


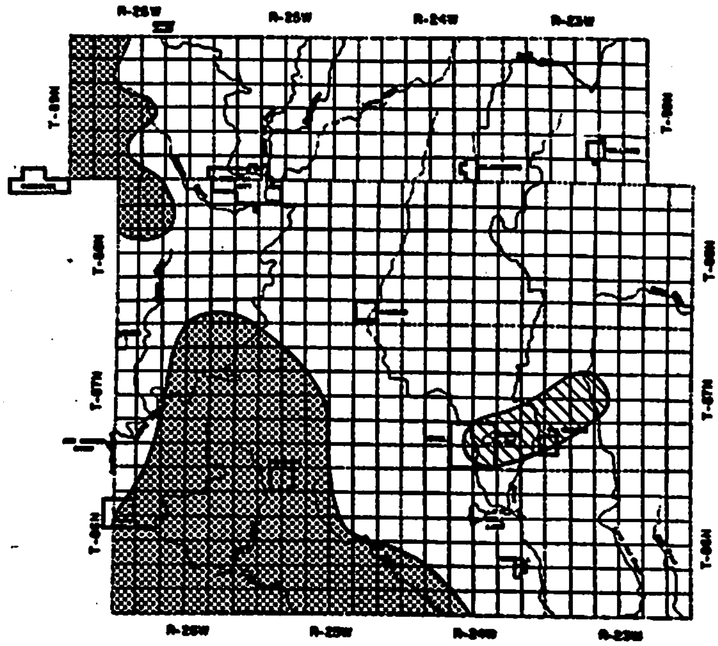
Figure 9

RANGE IN DEPTH TO HAMILTON COUNTY'S PRINCIPAL ROCK AQUIFERS

	R-26W	R-25W	R-24W	R-23W
T-89N	BEDROCK 85-100 PENNSYLVANIAN 85-175 MISSISSIPPIAN 95-220 DEVONIAN 425-580 Є-O 1475-1600	BEDROCK 10-135 PENNSYLVANIAN — MISSISSIPPIAN 10-135 DEVONIAN 450-480 Є-O 1350-1500	BEDROCK 130-180 PENSYLVANIAN 150 MISSISSIPPIAN 130-180 DEVONIAN 550-610 Є-O 1475-1650	BEDROCK 100-165 PENNSYLVANIAN 125 MISSISSIPPIAN 100-165 DEVONIAN 620-650 Є-O 1475-1600
T-88N	BEDROCK 90-240 PENNSYLVANIAN 90-125 MISSISSIPPIAN 130-240 DEVONIAN 475-590 Є-O 1450-1680	BEDROCK 20-190 PENNSYLVANIAN 55-125 MISSISSIPPIAN 20-190 DEVONIAN 450-570 Є-O 1400-1750	BEDROCK 110-170 PENNSYLVANIAN 110-170 MISSISSIPPIAN 120-245 DEVONIAN 500-615 Є-O 1500-1700	BEDROCK 110-160 PENNSYLVANIAN 110-155 MISSISSIPPIAN 125-290 DEVONIAN 640-675 Є-O 1525-1800
T-87N	BEDROCK 90-195 PENNSYLVANIAN 90-195 MISSISSIPPIAN 100-270 DEVONIAN 450-600 Є-O 1475-1840	BEDROCK 80-210 PENNSYLVANIAN 80-145 MISSISSIPPIAN 145-210 DEVONIAN 600-630 Є-O 1775-1880	BEDROCK 65-180 PENNSYLVANIAN 65-180 MISSISSIPPIAN 110-225 DEVONIAN 525-600 Є-O 1500-1850	BEDROCK 70-190 PENNSYLVANIAN 90-190 MISSISSIPPIAN 70-210 DEVONIAN 700-750 Є-O 1650-1850
T-86N	BEDROCK 80-210 PENNSYLVANIAN 80-145 MISSISSIPPIAN 145-210 DEVONIAN 600-630 Є-O 1750-1880	BEDROCK 100-265 PENNSYLVANIAN 100-275 MISSISSIPPIAN 144-345 DEVONIAN 600-610 Є-O 1700-1880	BEDROCK 40-200 PENNSYLVANIAN 40-150 MISSISSIPPIAN 85-220 DEVONIAN 500-600 Є-O 1700-1900	BEDROCK 25-150 PENNSYLVANIAN — MISSISSIPPIAN 25-150 DEVONIAN 700-825 Є-O 1800-2000

Figure 10

MISSISSIPPIAN AQUIFER IN HAMILTON COUNTY

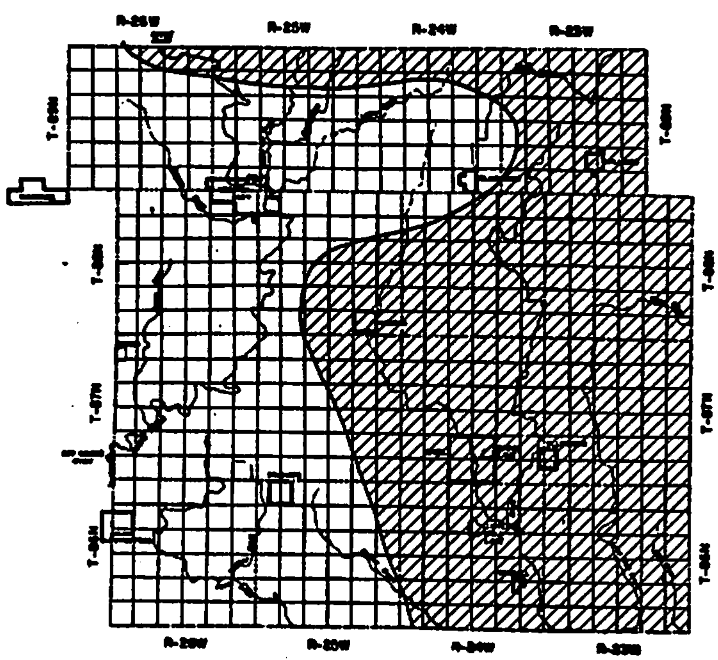


a. Water yields to wells in gallons per minute (gpm)

Below 20

50-100

20-50



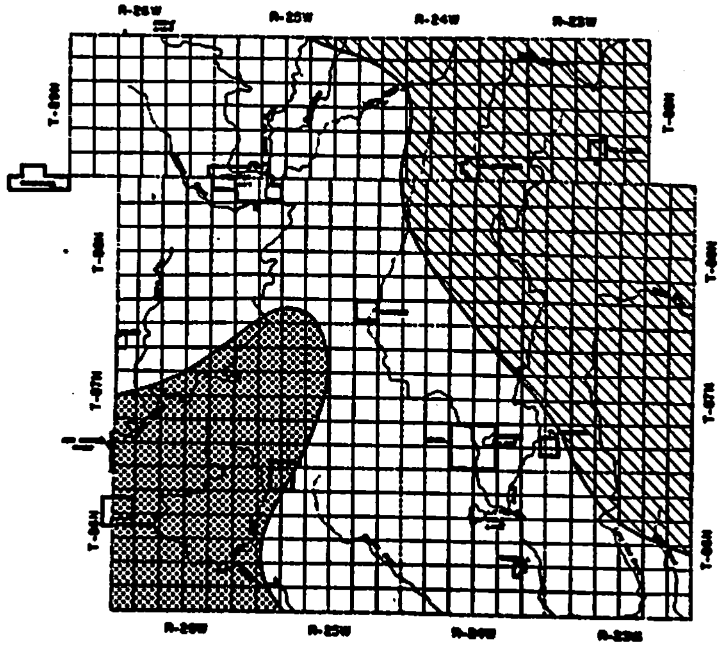
b. Dissolved solids content in milligrams per liter (mg/l)

500-750

250-500

Figure 10

MISSISSIPPIAN AQUIFER IN HAMILTON COUNTY

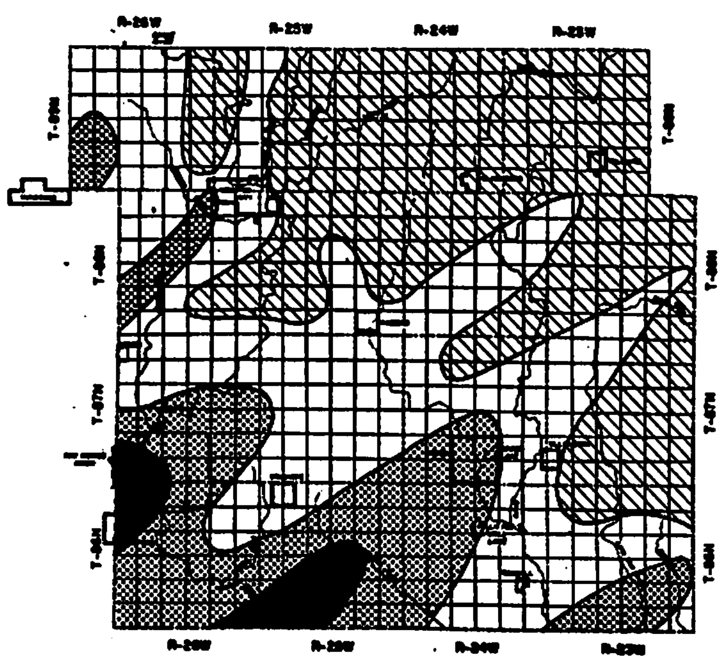


c. Water levels in wells in feet above mean sea level

1100-1200

900-1000

1000-1100



d. Elevation of Mississippian Aquifer in feet above mean sea level

700-800

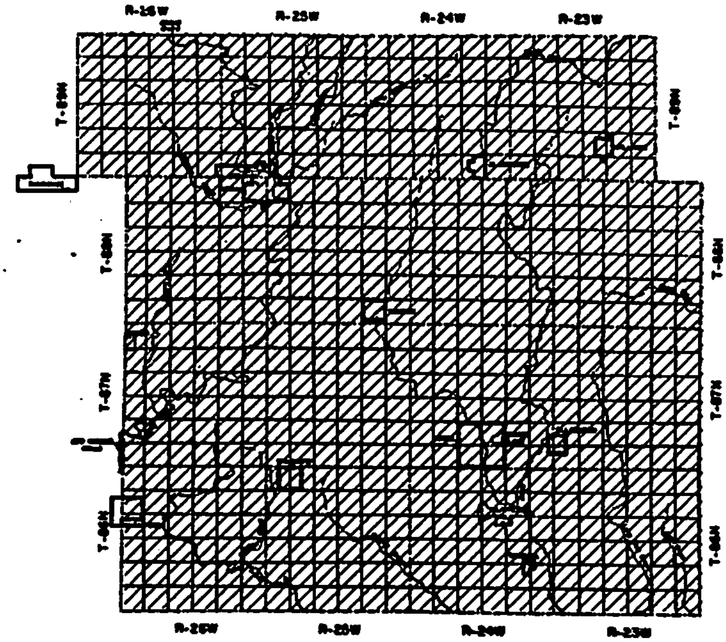
900-1000

800-900

1000-1100

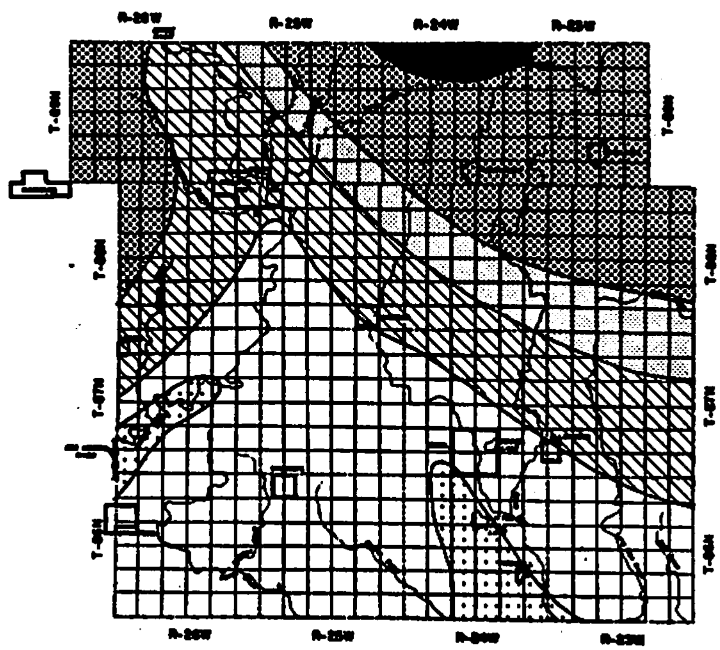
Figure 11

DEVONIAN AQUIFER IN HAMILTON COUNTY



a. Water yields to wells in gallons per minute

20-50



b. Water levels in wells in feet above mean sea level

1150-1200

1100-1150

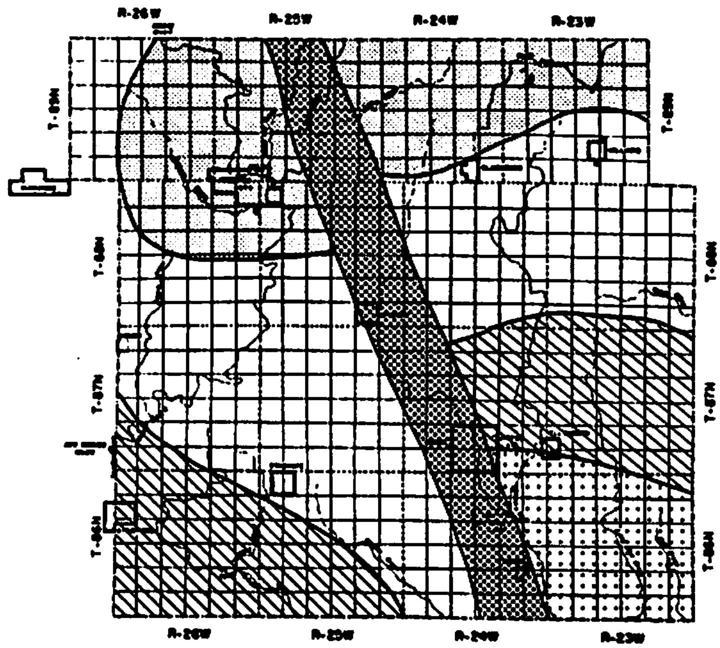
1050-1100

1000-1050

950-1000

900-950

Figure 11
DEVONIAN AQUIFER IN HAMILTON COUNTY



c. Elevation of Devonian Aquifer in feet above mean sea level

300-400

400-500

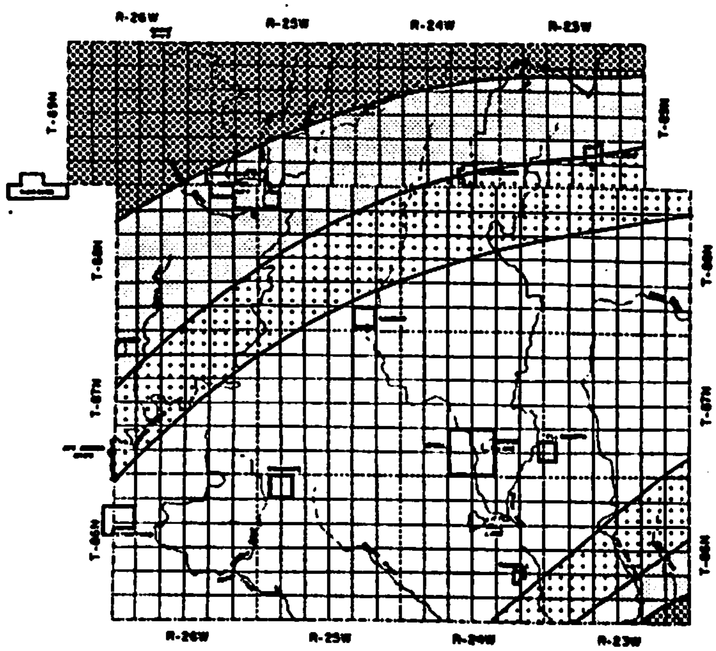
500-600

600-700

Zone where top of aquifer changes from top of the Cedar Valley carbonate east to top of the Lime Creek carbonate to the west

Figure 11

DEVONIAN AQUIFER IN HAMILTON COUNTY



d. Dissolved solids content in milligrams per liter (mg/l)

2000-2500

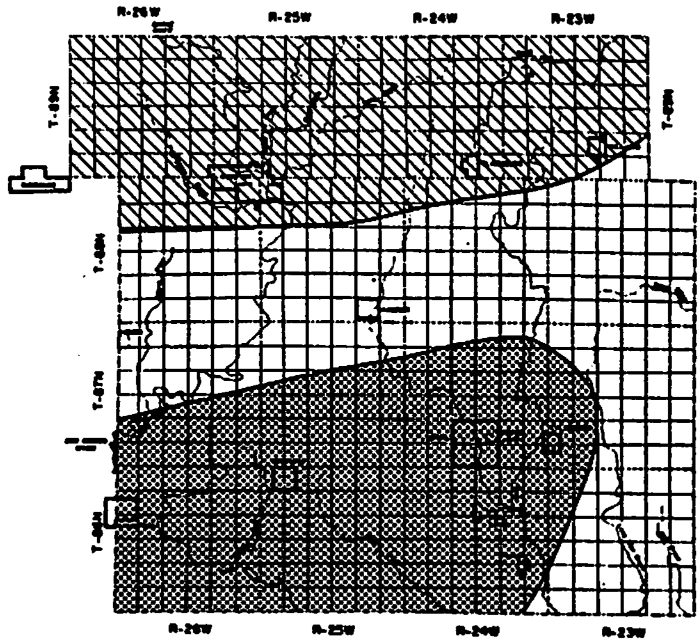
1500-2000

1000-1500

500-1000

Figure 12

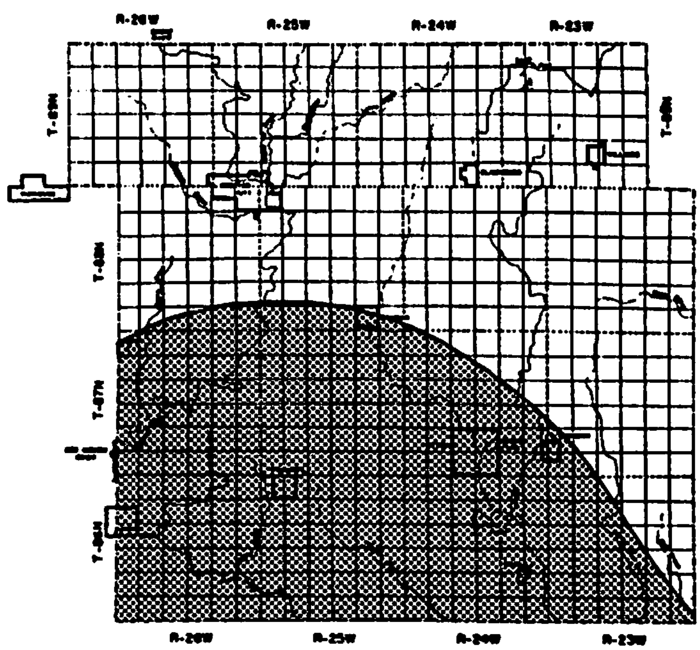
CAMBRO-ORDOVICIAN (JORDAN) AQUIFER IN HAMILTON COUNTY



a. Water yields to wells in gallons per minute (gpm)

200-500 Over 1000

500-1000

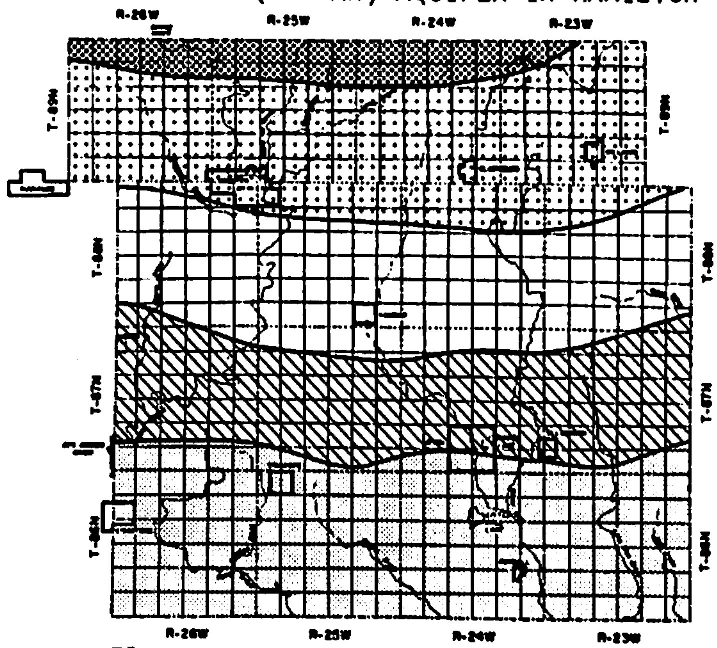


b. Dissolved solids content in milligrams per liter (mg/l)

750-1000 1000-1250

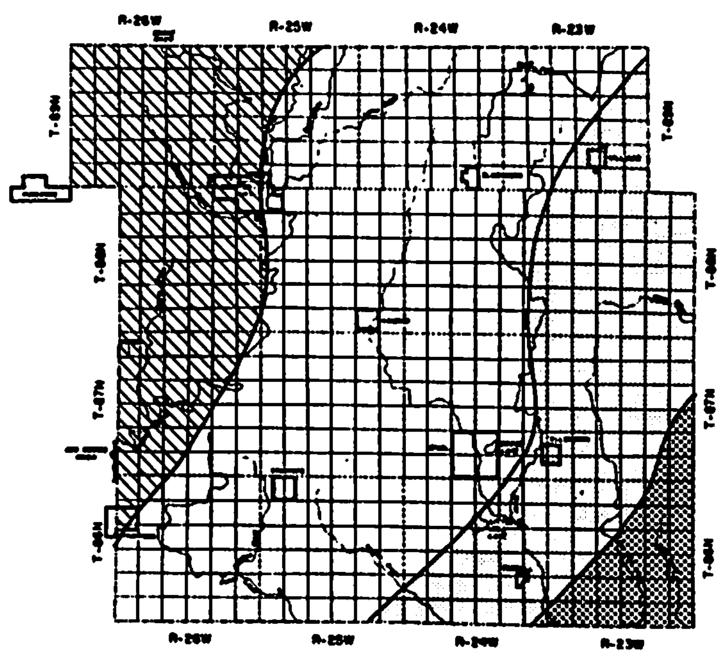
Figure 12

CAMBRO-ORDOVICIAN (JORDAN) AQUIFER IN HAMILTON COUNTY



c. Elevation of Jordan Sandstone in feet below mean sea level

- -600-700
- -700-800
- -800-900
- -900-1000
- -1000-1100



d. Water levels in wells in feet above mean sea level

- 750-800
- 800-850
- 850-900
- 900-950

Figure 13

INDEX MAP FOR TYPICAL WELLS IN HAMILTON COUNTY

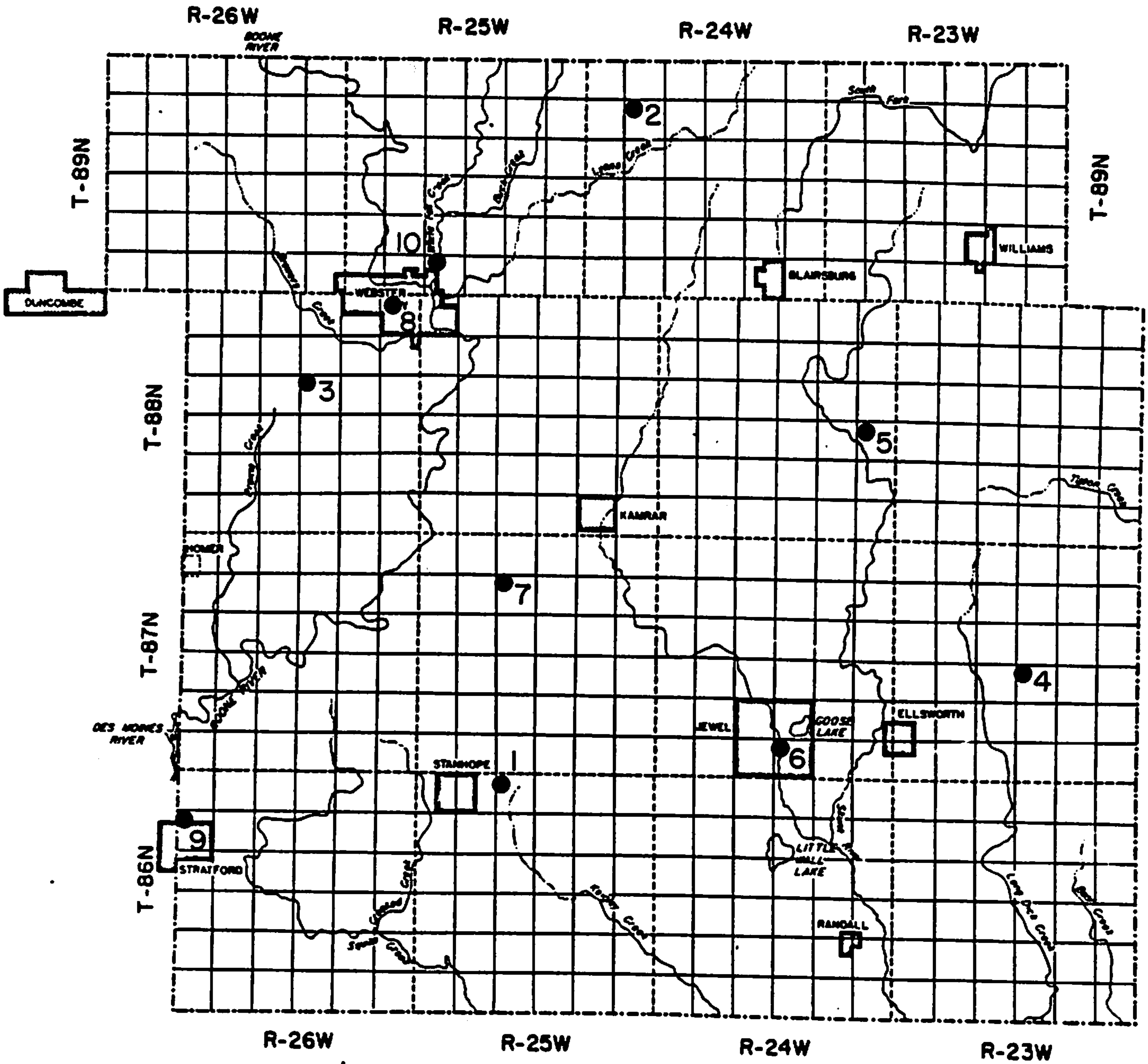


Figure 14

TYPICAL WELLS IN HAMILTON COUNTY

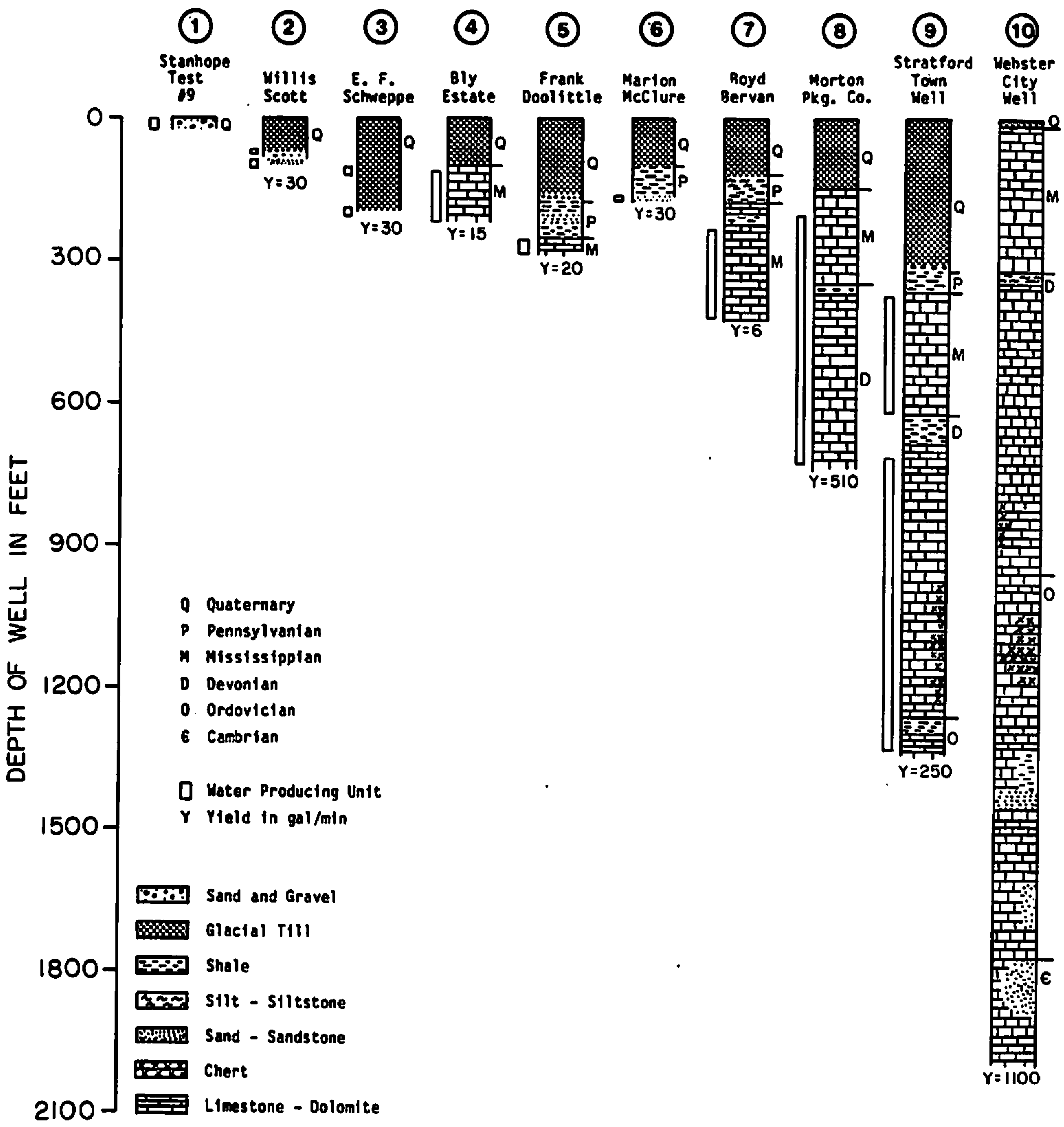


Table 2

SIGNIFICANCE OF MINERAL CONSTITUENTS AND PHYSICAL PROPERTIES OF WATER

Constituent or Property	Maximum Recommended Concentration	Significance
Iron (Fe)	0.3 mg/l	Objectional as it causes red and brown staining of clothing and porcelain. High concentrations affect the color and taste of beverages.
Manganese (Mn)	0.05 mg/l	Objectionable for the same reasons as iron. When both iron and manganese are present, it is recommended that the total concentration not exceed 0.3 mg/l.
Calcium (Ca) and Magnesium (Mg)		Principal causes for hardness and scale-forming properties of water. They reduce the lathering ability of soap.
Sodium (Na) and Potassium (K)		Impart a salty or brackish taste when combined with chloride. Sodium salts cause foaming in boilers.
Sulfate (SO_4)	250 mg/l	Commonly has a laxative effect when the concentration is 600 to 1,000 mg/l, particularly when combined with magnesium or sodium. The effect is much less when combined with calcium. This laxative effect is commonly noted by newcomers, but they become acclimated to the water in a short time. The effect is noticeable in almost all persons when concentrations exceed 750 mg/l. Sulfate combined with calcium forms a hard scale in boilers and water heaters.
Chloride (Cl)	250 mg/l	Large amounts combined with sodium impart a salty taste.
Fluoride (F)	2.0 mg/l	In central Iowa, concentrations of 0.8 to 1.3 mg/l are considered to play a part in the reduction of tooth decay. However, concentrations over 2.0 mg/l will cause the mottling of the enamel of children's teeth.
Nitrate (NO_3)	45 mg/l	Waters with high nitrate content should not be used for infant feeding as it may cause methemoglobinemia or cyanosis. High concentrations suggest organic pollution from sewage, decayed organic matter, nitrate in the soil, or chemical fertilizer.
Dissolved solids	500 mg/l	This refers to all of the material in water that is in solution. It affects the chemical and physical properties of water for many uses. Amounts over 2,000 mg/l will have a laxative effect on most persons. Amounts up to 1,000 mg/l are generally considered acceptable for drinking purposes if no other water is available.
Hardness (as $CaCO_3$)		This affects the lathering ability of soap. It is generally produced by calcium and magnesium. Hardness is expressed in milligrams per liter equivalent to $CaCO_3$ as if all the hardness were caused by this compound. Water becomes objectionable for domestic use when the hardness is above 100 mg/l; however, it can be treated readily by softening.
Temperature		Affects the desirability and economy of water use, especially for industrial cooling and air conditioning. Most users want a water with a low and constant temperature.

Water Quality

To the user, the quality of groundwater is as important as the amount of water that an aquifer will yield. As groundwater moves through soil and rock materials, it dissolves some of the minerals which, in turn, affect water quality. In addition to mineral content, bacterial and chemical contamination may be introduced through poorly constructed wells and seepage from other pollution sources.

Recommended standards for the common mineral constituents in water are described in the table above. These are accepted as guidelines for drinking water supplies. Limits for uses other than drinking often differ from these. For instance, water that is unacceptable for drinking and household use may be completely satisfactory for industrial cooling.

From past analyses of groundwater, the averages (A) and ranges (R) of values in milligrams per liter (mg/l) for several constituents are summarized in Tables 3 and 4 for the surficial and bedrock aquifers in Hamilton County. Recommended concentrations for some constituents are often exceeded without obvious ill effects, although the water may be palatable. Water-quality analyses for individual wells should obtained to determine if concentrations of constituents that affect health are exceeded.

Table 3

CHEMICAL CHARACTER OF GROUND WATER

Average (A) Range (R)	Temperature °C	Dissolved Solids	Hardness (as $CaCO_3$)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Potassium (K)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)*	Fluorine (F)	Nitrate (NO_3)	pH	Specific Conductivity
Alluvial Aquifer																
No information available																
Drift Aquifer																
A	11.2	759	524	4.2	0.24	130.4	46.9	5.4	47	441.4	211.8	13.8	0.7	0.3	7.3	1056
R	10-14	401-2046	229-1100	0.08-8.4	0.05-.9	62.8-253	34-106	2.6-12.1	9.7-148	276-671	3.4-1090	0.5-24	0.2-.9	0.1-.8	7.1-7.5	674-2300
Pennsylvanian Aquifer																
No information available																
Mississippian Aquifer																
A	11.7	829	485	2.0	0.04	101	69.9	10.0	40.2	418	218	5.6	1.6	1.1	7.4	984
R	7.8-13	356-2100	177-1630	0.03-8.5	0.01-0.33	27.6-352	24-664	2.8-19.6	11.2-64.8	220-538	1.2-1322	0.4-27.0	0.2-2.4	<.01-14.0	7.0-8.1	506-2560
Devonian Aquifer																
(Only 1 analysis available)																
	—	900	527	27	.05	114	59	151	50	266	408	20.5	3.3	.1	7.5	1100
Cambro-Ordovician Aquifer																
A	14.4	1060	547	2.1	0.05	127	56	20.4	116.8	366.4	438	46.8	1.6	1.1	7.3	1458
R	13-16	754-2054	394-1120	0.21-11	<.01-0.12	88-256	41.3-117	16-25	49-160	327-431	220-1082	7-68	1.2-2.3	<.1-5.9	6.9-7.6	1100-2330

* Most of the data is collected from chlorinated well systems so these figures are probably high.

There is no data available on the quality of water from alluvial aquifers in Hamilton County, but in general, alluvial sources yield the least mineralized groundwater in central Iowa. Alluvial aquifers are however, the most susceptible to contamination as they are recharged from precipitation by infiltration and stream seepage.

In the drift aquifer the water is hard and contains high concentrations of iron, manganese, sulfate, and total nitrate and bacteria concentrations may exceed recommended limits due to well contamination from surface sources. The water in the drift aquifer is usually acceptable for most purposes if wells are constructed properly and located suitable distances from sources of contamination. Nitrate content should be checked carefully in shallow wells, and any water supply containing over 45 mg/l should not be used for infant feeding.

The Mississippian Aquifer is the most heavily used of the bedrock aquifers in Hamilton County. The water quality is generally better to the north and east where the Mississippian outcrops as opposed to where if is overlain by the Pennsylvanian. The dissolved solids content averages less than 1000 mg/l although locally it may be high. Fluoride and sulfate concentrations exceed recommended standards in the southwest part of the county. Iron concentrations are high.

Little data is available for the Devonian aquifer in Hamilton County. The water is of poor quality in central Iowa with high concentrations of total dissolved solids, iron, sulfate and fluoride.

The Cambro-Ordovician aquifer has the highest potential yield of the bedrock aquifers but is also the most highly mineralized. Total dissolved solids average over 1000 mg/l, increasing to the south and west. Sulfate concentrations also increase to the south and are higher than recommended limits, but the water is acceptable, as most users can adapt.

RECOMMENDATIONS FOR PRIVATE WATER WELLS

Contracting for Well Construction

To protect your investment and guarantee satisfactory well completion, it is a good idea to have a written agreement with the well driller. The agreement should specify in detail:

- size of well, casing specifications, and types of screen and well seal
- methods of eliminating surface and subsurface contamination
- disinfection procedures to be used
- type of well development if necessary
- test-pumping procedure to be used
- date for completion
- itemized cost list including charges for drilling per foot, for materials per unit, and for other operations such as developing and test pumping
- guarantee of materials, workmanship, and that all work will comply with current recommended methods
- liability insurance for owner and driller

Well Location

A well should be located where it will be least subject to contamination from nearby sources of pollution. The Iowa State Department of Health recommends minimum distances between a new well and pollution sources, such as cesspools (150 ft.), septic tanks (50 ft.), and barnyards (50-100 ft. and downslope from well). Greater distances should be provided where possible.

The well location should not be subject to flooding or surfacewater contamination. Select a well-drained site, extend the well casing a few feet above the ground, and mound earth around it. Diversion terraces or ditches may be necessary on slopes above a well to divert surface runoff around the well site.

In the construction of all wells, care should be taken to seal or grout the area beween the well bore and the well casing (the annulus), as appropriate, so that the surfacewater and other pollutants cannot seep into the well and contaminate the aquifer.

Locate a well where it will be accessible for maintenance, inspection, and repairs. If a pump house is located some distance from major buildings, and wired separately for power, continued use of the water supply will not be jeopardized by a fire in major buildings.

Water Treatment

Water taken from a private well should ideally be tested every six months. Studies have shown that wells less than 50 feet deep are subject to contamination, especially nitrate and bacteria, from surface sources. The University of Iowa Hygienic Laboratory will do tests for coliform bacteria, nitrate, iron, hardness, and iron bacteria in drinking water for private individuals. Special bottles must be used for collecting and sending water samples to the laboratory. A sample kit can be obtained by writing to the University Hygienic Laboratory, University of Iowa, Oakdale Campus, Iowa City, Iowa 52242. Indicate whether your water has been treated with chlorine, iodine, or bromine, as different sample bottles must be used for treated and untreated water. The charge for the bacterial test is $6; for iron or hardness, $5; for nitrate, $9; and for iron bacteria, $10. If your well is determined to be unsafe, advice for correcting the problem can be obtained from your county or state Department of Health. Several certified private laboratories also run water analyses.

Shock chlorination is recommended following the construction and installation of a well and distribution system, and any time these are opened for repairs or remodeling. A strong chlorine solution is placed in the well and complete distribution system to kill nuisance and disease-causing organisms. If the first shock chlorination does not rid the water supply of bacteria it should be repeated. If this does not solve the problem, as it may not with shallow wells, the water should be continuously disinfected with proper chlorination equipment.

Since most of the groundwater in Hamilton County is mineralized, water-softening and iron-removal equipment may make water more palatable and pleasant to use. Softened water contains increased sodium; contact your physician before using a softener if you are on a sodium-restricted diet. Chlorination followed by filtration will remove most forms of iron and iron bacteria. Iron bacteria has no adverse effect on health, but it will plug wells, water lines, and equipment and cause tastes and odors. Iron-removal equipment can be used if problems persist.

Well Abandonment

Wells taken out of service provide easy access for pollution to enter aquifers supplying water to other wells in the vicinity. Unprotected wells may also cause personal injury. Proper abandonment procedures should be followed to restore the natural conditions that existed before well construction and prevent any future contamination. Permanent abandonment requires careful sealing. The well should be filled with concrete, cement grout, or sealing clays throughout its entire length. Before dug or bored wells are filled, at least the top 10 feet of lining should be removed so surfacewater will not penetrate the subsurface through a porous lining or follow cracks in or around the lining. The site should be completely filled and mounded with compacted earth.

ABANDONED WELLS SHOULD NEVER BE USED FOR DISPOSAL OF SEWAGE OR OTHER WASTES.

SOURCES OF ADDITIONAL INFORMATION

In planning the development of a groundwater supply or contracting for the drilling of a new well, additional or more specific information is often required. This report section lists several sources and types of additional information.

State Agencies That May Be Consulted

Iowa Geological Survey[1]	123 North Capitol Street Iowa City, IA 52242	(319) 338-1173
State Health Department[2,6]	Lucas Building Des Moines, IA 50319	(515) 281-5787
Dept. of Water, Air and Waste Management[3,4]	Wallace Building Des Moines, IA 50319	(515) 281-8690
University Hygienic Laboratory[5]	U of IA, Oakdale Campus Iowa City, IA 52242	(319) 353-5990
Cooperative Extension Service in Agric. and Home Economics[6]	110 Curtis Hall, ISU Ames, IA 50011	(515) 294-4569

Functions:

[1]Geologic and groundwater data repository, consultant on well problems, water development, and related services

[2]Drinking water quality, public and private water supplies

[3]Water-withdrawl regulation and Water Permits for wells withdrawing more than 5000 gpd

[4]Municipal supply regulation and well-construction permits

[5]Water-quality analysis

[6]Advice on water-systems design and maintenance

Well Drillers and Contractors

The listing provided here was drawn from an Iowa Geological Survey mailing list and yellow pages of major towns in phone books. Those selected are within an approximate radius of 50 miles of Hamilton County. For a state-wide listing, contact either the Iowa Water Well Driller's Assn., 4350 Hopewell Avenue, Bettendorf, IA 51712, (319) 355-7528 or the Iowa Geological Survey, (319) 338-1173.

Beemer Well Company
RR #2
Webster City, IA 50036

Andrew B. Croot
Box 427
Iowa Falls, IA 50126

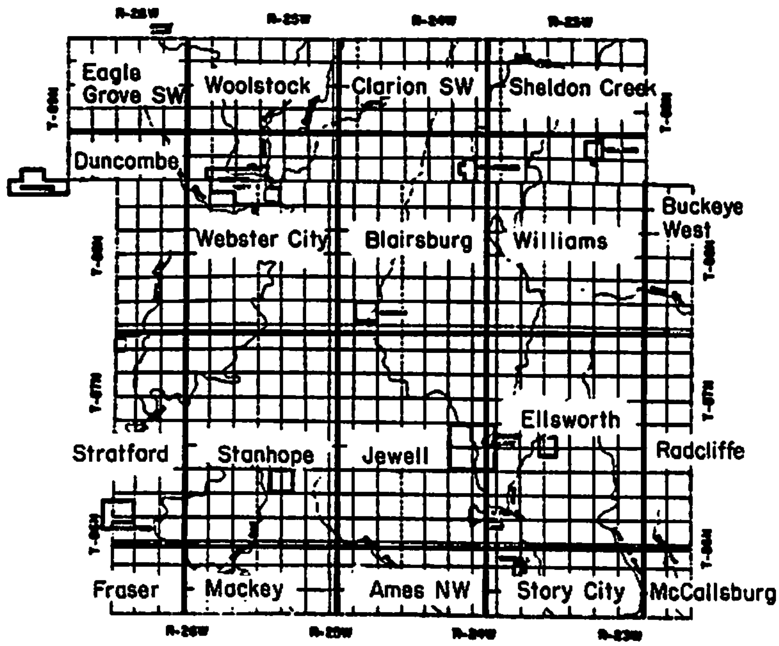
Lee's Pump and Repair/Pieters Well Company
Box 445
Steamboat Rock, IA 50672

Leopold Well Boring
RR #2
Madrid, IA 50036

R & R Well Company
RR 1
Fort Dodge, IA 50501

Tell Well Company
408 Third North
Dayton, IA 50530

Topographic Maps (Available from the Iowa Geological Survey)



Map Title	Date (Published)	Scale	Contour Interval
Ames NW	1975	1:24,000	10'
Blairsburg	1978	1:24,000	10'
Buckeye West	1979	1:24,000	10'
Clarion SW	1978	1:24,000	10'
Duncombe	1978	1:24,000	10'
Eagle Grove SW	1978	1:24,000	10'
Ellsworth	1978	1:24,000	10'
Fraser	1978	1:24,000	10'
Jewell	1965	1:24,000	10'
Mackey	1975	1:24,000	10'
McCallsburg	1979	1:24,000	10'
Radcliffe	1978	1:24,000	10'
Sheldon Creek	1978	1:24,000	10'
Stanhope	1978	1:24,000	10'
Story City	1975	1:24,000	10'
Stratford	1978	1:24,000	10'
Webster City	1978	1:24,000	10'
Williams	1978	1:24,000	10'
Woolstock	1978	1:24,000	10'

Useful Reference Materials

Horick, P.J., 1984, Silurian-Devonian Aquifer of Iowa, Iowa Geological Survey, Misc. Map Series No. 10.

Horick, P.J., and Steinhilber, W.L., 1973, Mississippian aquifer of Iowa, Iowa Geological Survey, Misc. Map Series No. 3.

Horick, P.J., and Steinhilber, W.L., 1978, Jordan aquifer of Iowa, Iowa Geological Survey, Misc. Map Series No. 6.

Iowa State Department of Health, 1971 Sanitary standards for water wells, State Department of Health, Environmental Engineering Service.

Twenter, F.R., and Coble, R.W. 1965, The water story in central Iowa, Iowa Geological Survey Water Atlas No. 1.

Van Eck, O.J, 1971, Optimal well plugging procedures, Iowa Geological Survey, Public Information Circular No. 1.

Van Eck, O.J, 1978, Plugging procedures for domestic wells, Iowa Geological Survey, Public Information Circular No. 11.